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Structural Characterization of Materials for Magnetic Recording Heads and Disks

M.F. Toney, M. Doerner, T. Lin, and D. Mauri (IBM)

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Introduction: X-ray diffraction measurements have been conducted to structurally characterize the materials used in magnetic recording heads and disks. On the head side, present read heads are spin valves (F/Cu/F/AF, where F-ferromagnet and AF=antiferromagnet) and in these structures, a critical thickness of the antiferromagnetic layer is needed to develop exchange coupling between the F and AF. On the disk side, measurements were made on IBM's 35 Gb/in^2 demonstration disk and have shed light on the reasons for the media's good performance.[1] Measurements were also made on recording materials that have the potential for use in perpendicular recording.

Methods and Materials: For the head material, we conducted measurements of the structure and chemical order in annealed MnPt (the AF) spin valves as a function of MnPt thickness. For the disk materials, we looked for fcc defects in the hcp Co-alloy, and measured crystallographic orientational information.

Results: For the head material, both exchange and chemical order develop with increasing thickness and the data show a correlation between these quantities. For the disk, data showed that this medium has a low level of fcc defects in the hcp Co-alloy which contributes to the high coercivity and thermal stability. We also found that the media has a high degree of preferred orientation, which results from the choice of seed layers and deposition conditions and results in high coercive squareness for good overwrite. In addition, there is no evidence of misoriented (c-axis) grains, which contribute to the high signal-to-noise ratio. In the materials for perpendicular recording, our data show that there is significantly more fcc Co-alloy than in comparable longitudinal media (ca < 30% compared with < 10%).

Conclusions: For MnPt spin valves, chemical order is required for the MnPt to be antiferromagnetic. These experiments unambiguously show why there is no exchange for thin films (no chemical order) and further show that the development of chemical order is necessary but not sufficient for strong exchange coupling. This is similar to what we found previously for NiMn spin valves as well as FePt films. This suggests there is a common mechanism to this thickness dependence, which we believe is related to the nucleation of chemically ordered grains.

The 35Gb/in^2 disk performs well because of low fcc defect density in the Co-alloy, a high degree of preferred orientation, and no apparent misoriented grains.

The presence of significantly more fcc Co-alloy in the perpendicular media explains the low coercivity and thus poor recording performance in this type of recording media. Since the anisotropy of fcc Co is small, the presence of the fcc Co-alloy results in the low coercivity.

References:

1 M.F. Doerner, K. Tang, T. Arnoldussen, H. Zeng, M.F. Toney, "Microstructure and Thermal Stability of Advanced Longitudinal Media," IEEE Trans. Magn. **36**, *43,* 2000; M.F. Doerner, X. Bian, M. Madison, K. Tang, Q. Peng, A. Polcyn, T. Arnoldussen, M.F. Toney, M. Mirzamaani, K. Tanako, E. Fullerton, D. Margulies, M. Schabes, K. Rubin, M. Pinarbasi, S. Yuan, M. Parker, D. Weller, "Demonstration of 35 Gb/in^2 Media on a Glass Substrate," IEEE Trans. Magn. **37**, *1052,* 2001.